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Cost factors involved in educational television programs are analyzed. Basic assumptions underlying the analysis are: television is to be used as a major resource in the educational process; for purposes of analysis, a television course consists of a series of 144 half-hour programs, presented four times weekly throughout a 36-week school year; programs originate from studios specifically designed to facilitate instructional programs, and professional production techniques comparable to those used in commercial television broadcasting are used; and the total level of television teaching activity is large enough to provide efficient loads for the studios and television tape machines, and all facilities operate on a 40-hour week and a 50-week year.

Studio operating costs are subdivided according to whether the studios are equipped with vidicon or image orthicon camera equipment. Capital investments, annual expenses, and studio efficiency are treated separately. The equipment investment for a vidicon camera setup is $60,000, whereas the investment with image orthicon cameras is $92,000. Total annual expenses for the former is $47,500; for the latter it is $58,100. Production costs per course would be $19,950 and $21,280 respectively. The cost per program would be $138 for vidicon and $148 for image orthicon. Capital investment in a pair of TV tape machines is $90,000; for a pair of economy model TV tape machines, $60,000.

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A SIMPLIFIED ANALYSIS OF COST FACTORS IN THE PRODUCTION AND RECORDING OF INSTRUCTIONAL TELEVISION PROGRAMS

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A. OBJECTIVES

The information contained in this bulletin is offered to educators with little or no television production experience as a general guide to the cost factors involved in producing and recording instructional television programs. Costs associated with the distribution, reception, and utilization of such programs are not included in this analysis, but must also be considered when planning a budget for a complete ETV project.

B. BASIC ASSUMPTIONS

The economic studies reported in this bulletin were necessarily based on certain assumptions with respect to program objectives, production techniques, and salary scales. Since these assumptions do not hold true for all ETV projects, it is important that they be spelled out in sufficient detail to permit the users of this bulletin to make appropriate adjustments for cost factors that may be substantially different in specific cases.

This analysis is based on the assumption that television is to be used as a "major resource" in the educational process. That is, the "hard core" of new information in each televised course is presented via television, but the classroom teacher continues to play an important role, supplementing the efforts of the studio teacher through class discussion, recitation, drill, quizzing, and individual coaching. For simplicity, a "TV course" is assumed to consist of a

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series of 144 half-hour programs, presented four times weekly throughout a 36-week school year. In most cases, the actual class periods would be 50 to 60 minutes in length, with time allocated before or after the telecast lessons for class activities. In some cases, a fifth class period might be used each week for testing or additional class work.

It is also assumed that programs are to originate from studios specifically designed to facilitate instructional programs, and that professional production techniques comparable to those used in commercial television broadcasting are to be employed. It should be noted that this assumption has a rather profound influence on the cost factors. It is possible to produce programs at substantially less cost than reported here by abandoning professional production techniques in favor of simple observational techniques wherein television cameras are used essentially to view teachers making conventional classroom presentations. It is assumed, however, that most educators are interested in television as a means of improving the quality of instruction, and such improvement requires the use of production techniques which either exploit the favorable properties of the medium or compensate for its limitations. Educators who are forced by financial or other considerations to use less than the best professional techniques should at least be aware of the extent of the compromises they have made.

Still another basic assumption is that the total level of TV teaching activity is great enough to provide efficient loads for the studios and TV tape machines, and that all facilities are operated on the basis of a 40-hour week and a 50-week year (allowing only a 2-week vacation shutdown period). This assumption also has a major influence on the cost factors; television programs can be very expensive if the total cost of owning and operating elaborate facilities must be applied to only a few courses involving only a few hours per week. Many ETV projects require financial subsidies in their early stages when television is applied cautiously in only a few areas, but the costs may become fully justifiable when local confidence in the medium permits its use on an intensive, efficient scale.

Further assumptions with respect to salary scales, time allowances, etc. will be spelled out at appropriate points in this bulletin.

C. STUDIO OPERATING COSTS

As a starting point in this economic analysis, let us review the costs involved in operating a 2-camera television studio with accompanying control room and film projection room, excluding, for the moment, the production costs associated with the people and materials placed before the cameras. Because of significant cost differences, separate columns are shown below for studios equipped with vidicon and image orthicon camera equipment.

1. Capital Investments

For purposes of this study, it is assumed that a teaching studio utilizing a pair of RCA TK-15 vidicon camera chains involves an equipment investment of $60,000. This investment also includes a film projection room with an RCA TK-21 vidicon film camera, two 16-mm projectors, and a professional slide projector.

A comparable studio employing the same film facilities but utilizing RCA TK-12 4-1/2-inch image orthicon cameras would require an equipment investment of approximately $92,000.

In both cases, it is assumed that the capital investment in the structure which houses the studio, control room, film room, and related offices and work spaces is about $50,000. At the reasonably typical cost of $15.00 per square foot, this investment would provide about 3,330 square feet, of which perhaps 1200 square feet would represent the studio floor. The remaining space should be ample for production activities as well as technical activities, so no further allowances will be made for space costs. Of course, in a 2 or 3-studio plant, the total building investment would be doubled or tripled, but the costs per studio would remain essentially the same.

2. Annual Expenses

	Studio	
	Vidicon	Image-Orthicon
a. Building amortization, assuming 20-year, straight-line depreciation. (The structure itself should last longer, but it is probable that extensive renovation will be required after 20 years).	$ 2,500	$ 2,500

	Studio Vidicon	Studio Image-Orthicon
b. Equipment amortization, assuming 5-year, straight-line depreciation (considering both wear and obsolescence).	$ 12,000	$ 18,400
c. Technical staff (operations and maintenance). Two technicians @ $7500 per year (actual salary levels vary with region). These people would handle video, audio, and projection equipment	$ 15,000	$ 15,000
d. Lighting Director/Floor Manager	$ 5,000	$ 5,000
e. Administration and Overhead (Each studio operation requires the part-time services of a general manager, a chief engineer, and clerical personnel. It is assumed that total administrative costs are distributed across at least 3 studios or comparable activities)	$ 12,000	$ 12,000
f. Technical Operating Costs (camera tubes, other renewal parts, lighting, power)	$ 1,000	$ 5,200
Totals	$ 47,500	$ 58,100

3. Studio Efficiency

The above studio operating costs may be pro-rated across several TV courses, the exact number depending upon the efficiency of the operation. The studio is assumed to be in operation for a total of 2,000 hours per year (50 weeks at 40 hours/week), and each "TV course" as defined for this study requires only 72 hours of actual program time. With proper scheduling and appropriate use of TV tape facilities, it is realistically possible to produce 8 courses per year from a single studio, allowing a "time budget" of 250 hours for each. This time budget corresponds to an efficiency factor of 29%, and permits about one hour and thirteen minutes of set-up time and "on-camera" rehearsal for each half-hour presentation. In practice, some of the studio time would probably be held in reserve for "specials", and the actual efficiency would vary greatly with the complexity of the subject matter and the skill and experience of the available personnel.

D. PRODUCTION COSTS PER COURSE

	Studio	
	Vidicon	Image Orthicon
a. Studio Operating Cost (approx.) (pro-rated across 5 courses)	$ 5,950	$ 7,200
b. Studio Teacher. It is assumed that a teacher is released from all other duties for a period of one year to prepare and conduct a TV course. During the actual "shooting" period, the teacher would devote essentially a full 8-hour day to the preparation of each half-hour program, plus discussions with classroom teachers and students. Additional time, preferably before the production schedule begins, should be allowed for the preparation of detailed lesson plans and the collection of basic materials. Studio teachers would normally be near the top of the local salary ranges. (National average for a classroom teacher's salary is $5,200).	$ 7,500	$ 7,500
c. Producer/Director. It is assumed that each course receives the half-time attention of a second qualified teacher, preferably one skilled in audio-visual presentation techniques. This person should work closely with the studio teacher, giving primary attention to the technique of presentation rather than the content. As a skilled specialist, the producer-director would probably command a salary roughly comparable to that of the studio teacher.	$ 3,250	$ 3,250
d. Cameramen, assuming 500 man-hours (2 cameramen) per course at $1.50/hour. In many cases, student labor may be used effectively for this activity, although it is normally best to use the same people throughout a given course.	$ 750	$ 750

	Studio Vidicon	Studio Image Orthicon
e. Production Materials and Services including the part-time services of graphic artists and photographers, plus expendable properties and raw materials for graphic arts and photography. (This cost factor will vary widely, depending upon subject matter and the availability of ready-made visual aids).	$ 2,500	$ 2,500
Total Cost per Course	$ 19,950	$ 21,280
Cost per Program	$ 138	$ 148

E. TV TAPE RECORDING COSTS

It is assumed that the TV tape facility consists of a pair of machines in operation 8 hours per day throughout the 50-week year, but actually pulling tape for a total of 2,000 machine-hours per year (an average of 4 hours per day per machine). This 50% efficiency factor is quite realistic, considering time allowances for rewinding, tape editing, and machine maintenance, plus schedule problems and the fact that both the school day and the school year are appreciably shorter than the work day and the work year.

The assumed "active" time of 2,000 machine hours is ample for the recording of 8 courses of 72 hours each (144 half-hour programs), plus two complete playbacks of each course, still allowing a total of 272 machine hours for rehearsals, tests, etc. Since the cost for playback is essentially the same as the cost for recording, a reasonable "cost per course operation" (either recording or playback) may be obtained by dividing the total annual expense for the tape facility by 3 x 8 or 24.

1. Capital Investments

Because of the significant cost differences, this analysis will show the costs of owning and operating either a pair of RCA TRT-1B TV tape machines or a pair of the RCA TR-11 "Economy Models" (which are compatible with the larger machines). In the former case, the total equipment investment, including recommended accessories, is approximately $90,000. In the latter case, the investment is approximately $60,000. Since the tapes produced by the

two types of machines are fully interchangeable, it would be possible to operate a facility with one machine of each type, in which case the investment would be approximately midway between these figures. The hourly operating costs for the two machines are quite comparable.

In addition to the equipment investment, the operation of a TV tape recording facility requires a significant investment in the tape itself. At the current price of about $220 per hour, each 72-hour course requires a capital investment of $15,840 in tape stock. Magnetic tape can be erased and re-used, and video tape is normally useful for a total of about 100 "passes" through the machine before it is worn out. Thus, the investment in tape depreciates at the rate of approximately $2.20 per hour of actual use time. For simplicity, this depreciation figure is employed in the following analysis, but it should be noted that when tape is used primarily for long-term storage of program materials, the lost interest on the capital tied up in the tape inventory may become a significant cost factor.

2. Annual Costs

	TR-11's	TRT-1B's
a. Equipment Amortization, assuming 5-year, straight line depreciation (taking into account both wear and obsolescence)	$ 12,000	$ 18,000
b. Technician (one man should be able to operate and maintain two machines)	7,500	7,500
c. Wear of Tape and Video Headwheels for a total of 2,000 machine hours	8,000	8,000
d. Miscellaneous Supplies and Parts	1,000	1,000
	$ 28,500	$ 34,500

3. Cost per Course

For each complete recording or playback operation for 144 half-hour programs, a realistic cost is the above total divided by 24	$ 1,190	$ 1,440

F. INTERPRETIVE COMMENTS

The reader is reminded at this point that the cost figures developed above are based on a number of assumptions, any one of which might cause wide variations in the results. The following comments are applicable only to the extent that the assumptions remain valid.

1. It is noteworthy that the cost differential between the use of professional vidicon and image orthicon camera equipment is not very great when all production costs are taken into account. The total saving per course of $1,330 by the use of vidicons is only 6.25% of the total cost using image orthicons, and actually much of this saving may be offset by the hidden costs involved in compensating for the less favorable operational characteristics of vidicons (vidicons require greater care in lighting and in adjusting signal levels). Even ignoring the production costs, the saving in studio operating costs resulting from the use of vidicons is only about 20%, since the major costs are for personnel, not equipment.

2. For rough budgetary purposes, the figures presented here may be "projected" in various ways. For example, highly efficient use of a single studio to produce a total of 8 televised courses (or the equivalent) on a full-year production schedule would require an annual budget of approximately 8 x $21,000 or $168,000 and the TV tape facility to "back up" this activity would require an additional budget of $35,000, assuming the use of TRT-1B machines. It is noteworthy that these figures include amortization of all facilities, implying either the financing of past purchases or the building of reserves to permit replacement of the capitalized equipment as it wears out or becomes obsolete. If amortization expense is not included, the annual budget for a fully loaded studio and TV tape facility could be reduced by about $38,900.

3. At the beginning of a new ETV project, few administrators would have the confidence to schedule a single studio for as many as 8 courses (or the equivalent); 4 would be a more probable number for "beginners". To arrive at an approximate budget for this situation without repeating the entire analysis, we might assume that the studio operating expenses shown under "C" above would be essentially the same, or approximately $58,000 for image orthicon equipment. We might then note that the production costs per course, excluding the studio costs, are $21,280 less $7,280 or $14,000. Four courses would require a production budget of 4 x $14,000 = $56,000, and the total budget would be approximately $58,000 + $56,000 or $114,000. During this learning period, the total cost per course would be approximately $28,500, assuming the use of image orthicon camera equipment.

4. Some of the economic benefits of TV tape recording are well illustrated by the following table, which assumes the use of TK-12 (image orthicon) camera equipment and TRT-1B TV tape equipment.

	No Recording	Recording Used Twice	Five Times	Ten Times
Original Production	$ 21,280	$21,280	$21,280	$21,280
Recording Cost	-	1,440	1,440	1,440
Playback Cost	-	2,880	7,200	14,400
Total	$ 21,280	$25,600	$29,920	$37,120
Cost per Use	$ 21,280	12,800	5,985	3,712

5. If the size of the student audience is known, it is a simple matter to translate the cost figures presented here into costs per student. For example, if a recorded TV course is used five times before audiences of 1,000 students for each use, the cost per student per course is approximately $6.00. For purposes of comparison, the national average cost per student per course for conventional classroom instruction is approximately $40, assuming that the "course" represents about 1/6th of the total instruction given each student. (This figure is an average for grades 1 through 12; college instruction costs somewhat more).

G. COST JUSTIFICATION

Realistic efforts to justify the costs of using televised instruction require knowledge of the ETV project objectives and the costs involved in alternative approaches to the same objectives. In college-level or adult-level situations where television classes can be conducted with relatively little supervision, the savings resulting from the use of television for lecture material may be great enough to provide immediate cost justification. (Provision must still be made for recitation, discussion, and testing, as in conventional instruction). In an elementary or secondary school situation where team-teaching is employed, however, the costs of televised instruction appear superficially as an additional expense, added to the usual expense of maintaining the teacher in the classroom. Viewed in terms of objectives, however, the use of television may result in significant savings rather than added expense.

For example, let us consider the case of a school system facing the need to teach a new foreign language to 1,000 students. For simplicity, let us assume that the course is to conform to our "standard TV course", so that the cost of producing the course by television would be approximately $21,000, as explained above. With proper assistance from the studio teacher, the existing classroom teachers could serve effectively at the classroom end of the system, even though they would not be competent to teach the language unaided. If television were not used, it would be necessary to hire at least 5 qualified

teachers (assuming they could be found), each of them handling 200 students in six different class groups, each group meeting four times per week. Assuming a salary level of $7,500 (for teaching ability comparable to that of the studio teacher), the salary costs alone would be $37,500 for this non-TV approach to the problem.

Further cost savings would be possible in a situation where a total program of instruction extends over more than one year. For example, if an advanced course in the same language considered above is to be offered during the second year of operation, the same studio teacher who produced the first-year course might be assigned to produce the advanced course, while the first-year course is simply played back from TV tape. For the conventional approach, an additional group of 5 teachers would have to be hired to handle 1,000 second-year students. Using TV, the total cost for two years' operation would be $46,880 (including $42,560 for producing two program series, 4,320 for recording and playback expenses). The total salary cost for the conventional approach would be $112,500 (assuming five teachers for the first year, ten for the second).

The savings in a single course might not justify a full-scale ETV project, especially when the additional expense of signal distribution is taken into account, but similar savings in science, art, music, and other specialized subject areas may provide ample cost justification. Still other savings may result from the more efficient use of school space for instructional purposes, or minor revisions in student/teacher ratios made reasonable by reducing the preparation burden for classroom teachers.

With respect to the quality of instruction, the television approach offers major advantages that are difficult to measure in financial terms. During the actual academic year, a studio teacher would be expected to produce only four half-hour programs during a 40-hour work week. Each of the non-TV teachers in the above example, on the other hand, would be in "active service" in the classroom for a total of 24 hours per week, and much of his (or her) additional time would be required for grading papers, consultation with students, and administrative duties, leaving very little time for lesson preparation.

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